

Measuring Vibration Using the DT9837, MATLAB Data Acquisition Toolbox, and MATLAB DAQ Adaptor

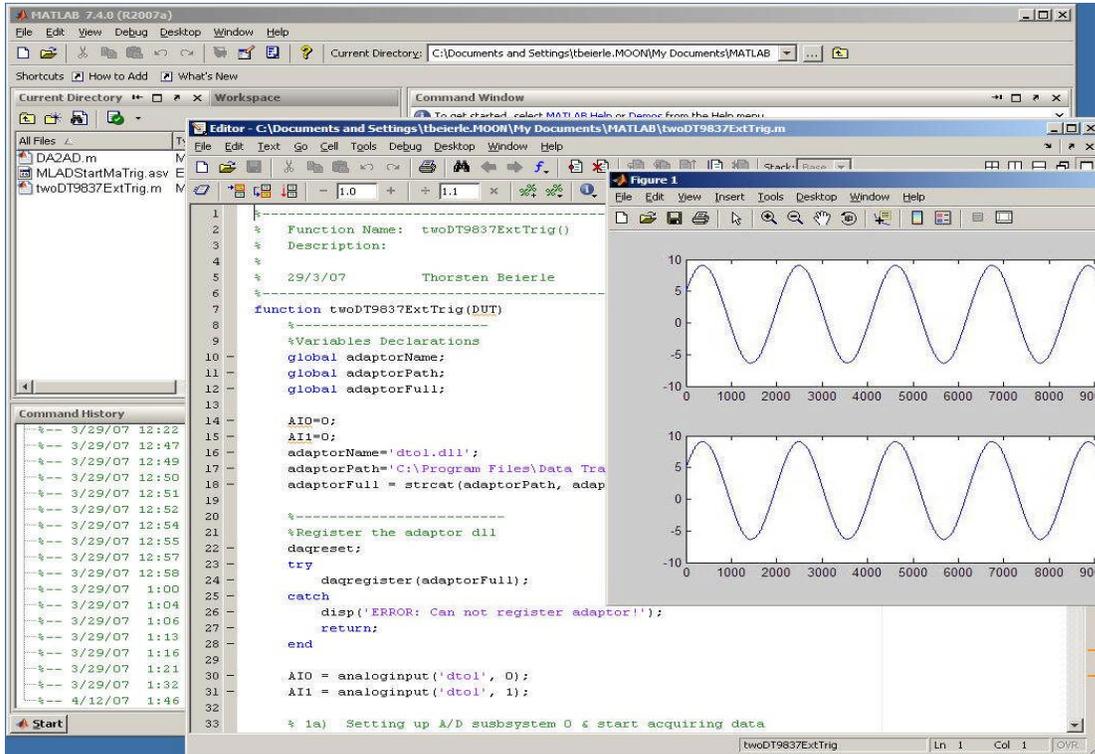
Challenge To measure the vibration of hard disk drives using a portable laptop solution and, thereby, reduce noise, improve product reliability, and reduce testing costs

Solution Use IEPE accelerometers with Data Translation's high-performance DT9837 USB modules, MathWork's MATLAB Data Acquisition Toolbox, and Data Translation's free MATLAB DAQ Adaptor to measure vibration data and present results

Results

- Portable vibration and analysis system that increases testing flexibility and reduces testing costs
- Standard software platform for ease of development and support
- Improved reliability of hard disk drives

For hard disk drive (HDD) manufacturers, reducing noise is critical in controlling vibration – a key parameter when assessing product reliability. In an HDD system, the read/write heads of the disk drive are only microns away from the storage disks. Too much vibration will cause the read/write heads to touch the disk, resulting in irreversible damage to the hard disk drive (also called a head crash). It is imperative, therefore, that engineers measure, analyze, and reduce vibration to improve product reliability.



Vibration Analysis Application in MATLAB

Challenge

This customer was using old and expensive oscilloscopes with IEPE current outputs to measure vibration. They wanted to update their test equipment to improve testing flexibility and reduce costs. Their stated requirements were as follows:

- Need a portable laptop solution to provide greater testing flexibility
- Need the ability to measure two IEPE accelerometers in all three geometrical directions (X, Y, and Z) at different rotational speeds
- Need highly accurate results
- Need to use MATLAB for compatibility with existing test applications

Solution

This customer had standardized on MATLAB as their software platform based on its data analysis capabilities, and needed a solution that was compatible with it.

From a hardware-perspective, the customer needed a laptop solution capable of measuring multiple IEPE accelerometers with precision and at different speeds of rotation. The high-performance DT9837 USB module proved to be an excellent fit for the following key reasons:

- **Simultaneous IEPE measurements** – The DT9837 supports four simultaneous IEPE inputs, including a 4 mA current source, and a tachometer input channel for synchronizing vibration measurements.
- **Accuracy** – The DT9837 provides four, 24-bit Delta-Sigma A/D converters and supports a wide pass band of 0.5 Hz to 25.8 kHz for high-resolution, low frequency measurements.
- **Portability** – The DT9837 connects to a laptop using a single USB cable and operates exclusively on USB power – no external power supply is needed.
- **Multiple Module Support** – Multiple DT9837 modules can be connected to a laptop through its USB ports or by using an external hub. In addition, the DT9837 provides an external trigger input for synchronizing the start of acquisition on multiple modules.
- **MATLAB Compatibility** – The MATLAB DAQ Adaptor, which ships free with the DT9837 module, allows MATLAB users to control all aspects of the module through the Data Acquisition Toolbox.

The customer used two DT9837 modules to measure the vibration of two X, Y, and Z IEPE accelerometers. The X, Y, and Z outputs of one accelerometer were connected to the analog input channels of the first DT9837 module, while the X, Y, and Z outputs of the second accelerometer were connected to the analog input channels of the second DT9837 module. In addition, tachometer inputs were connected to each module to measure the rotational speed of the HDD.

Both modules were connected to a shared external digital trigger input. When a rising-edge occurred on the external trigger input, both modules started acquiring data from the inputs. The rotational speed of the HDD (on the tachometer input) was measured in parallel with the vibration data of the HDD (on the IEPE inputs) to correlate vibration data at a specific rotational speed. The customer then increased and decreased the speed of rotation and measured the vibration of the HDD at those speeds

Using MATLAB, the data from each input channel was acquired, displayed as a waveform, and streamed to the hard drive of the laptop for further off-line analysis.

The customer was impressed at performance of the system and found that the high-resolution DT9837 USB module, coupled with MATLAB Data Acquisition Toolbox and the MATLAB DAQ Adaptor, was an ideal, portable solution for measuring noise and vibration data in HDD applications.

Results

- **Portable vibration and analysis system that increases testing flexibility and reduces testing costs.** The high-performance DT9837 USB module met the customer's requirement by replacing an expensive solution with a cost-effective, portable USB solution capable of measuring four IEPE inputs simultaneously at 24-bits of resolution.
- **Standard software platform for ease of development and support.** The MATLAB Data Acquisition Toolbox and the MATLAB DAQ Adaptor allowed users to access and control the DT9837 module easily and present the results graphically, in a single environment.
- **Improved reliability of hard disk drives.** Using the DT9837 USB module with the MATLAB Data Acquisition Toolbox and the MATLAB DAQ Adaptor, the customer was able to measure and analyze vibration data, reduce noise, and improve the reliability of their hard disk drives.

Products Used

DT9837, MATLAB Data Acquisition Toolbox, MATLAB DAQ Adaptor